

1.

(a)	One mark for both correct cells.	1
(b) (i)	Root <u>tip</u> / shoot <u>tip</u> / bud / cambium / meristem. (not : leaf / root)	1
(ii)	Anther / ovary / ovule.	1
(c)	One mark per correct cell	3
(d) (i)	Interphase.	1
(ii)	DNA replication; (1) protein synthesis; (1) organelle / mitochondria synthesis; (1) ATP synthesis / build up of energy supply / store. (1) Any 3.	3 [10]

2.

(a) (i)	1 = Anaphase	
(ii)	2 = Telophase	
(iii)	3 = Prophase	
(iv)	4 = Metaphase	4
(b)	3 4 1 2 Accept Prophase, Metaphase, Anaphase, Telophase.	1
(c)	Mitosis produces identical daughter cells. / Daughter cells contain the same number of chromosomes as parent. No pairing of homologous chromosomes / No bivalents. No chiasmata / No crossing over. Only one division. Mitosis produces 2 daughter cells, meiosis produces 4. Meiosis for sexual reproduction / makes gametes.	2
(d) (i)	<u>Plotting the graph -</u> Plotting the axes; Time – linear scale, with units, labelled. DNA – linear scale, with units, labelled. Minus 1 if not all paper used. Minus 1 if axes transposed. Correct plots; all correct $\pm \frac{1}{2}$ square.	1 1 1 1
<p>Sample of possible answer</p>		
(ii)	Replication of DNA. (not: reproduced / duplicates / copies) DNA value doubles, then DNA value halves / returns to original level. (Cell divides) by cytokinesis / cytoplasmic cleavage.	1 1 1

[13]

3.

a	i	meiosis (correct spelling only);	1
	ii	whole chromosomes separate; sister chromatids have not split chiasmata /crossing over has occurred/recombinant chromosomes;	2
	iii	anaphase I	1
b	i	concept of: enough DNA to allow splitting in cell division/DNA replicates/chromosomes double	1
	ii	each daughter cell has half the DNA;	1
c		independent /random assortment/separation of chromosomes /chromatids/ random alignment in metaphase; crossing over / chiasmata ; mutations (not : haploid gametes)	2

4.

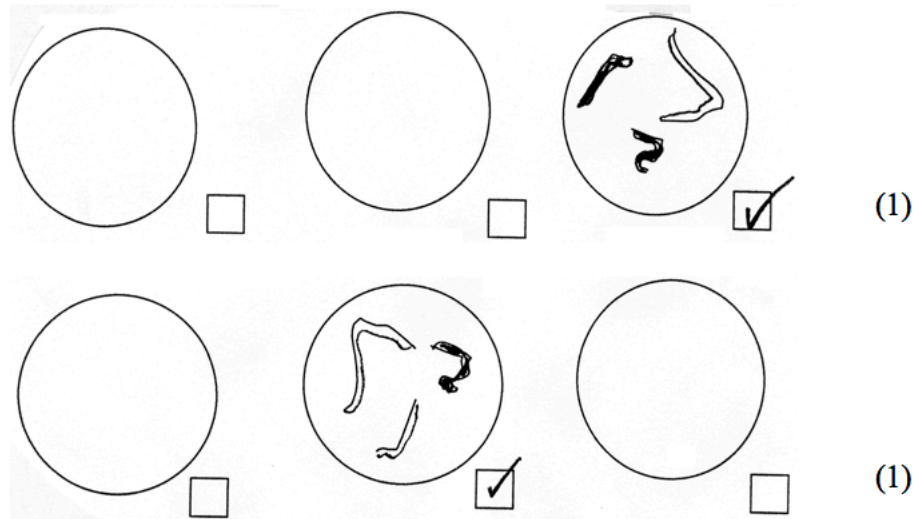
(a)	(i)	A	(1)
	(ii)	C	(1)
	(iii)	B	(1)
	(iv)	F	(1)
	(v)	E	(1)
	(vi)	C	(1)
(b)	(i)	4	(1)
	(ii)	2	(1)
(c)	Provides <i>haploid</i> cells (for mixing 2 sets at fertilisation) Random/Independent assortment shuffles chromosomes; Crossing over; Specific reference to trisomy (not : random fertilisation/mutation unqualified)		(3)

Total = 11 marks

5.

(a) 3 (1)

(b) (i)



-1 for each extra tick.

(ii) Any drawing with the 3 different chromosomes i.e. 3 shapes (with a different combination of filled not filled to those given in question e.g. all three filled or all three empty, largest one filled other two empty etc.) (1)

(iii) Half number of chromosomes/haploid;

Variation / genetically different;

Crossing over / chiasmata;

Diploid / original number of chromosomes is maintained when gametes fertilise OWTTE.

Independent assortment.

Any two (2)

- (c) (i) Complete the table below to show the main difference between meiosis and mitosis.

<u>Meiosis</u>	<u>Mitosis</u>
1. Double / bivalents / <u>homologous</u> / <u>synapsis</u>	1. Single chromosome (<u>allow</u> : no bivalent)
2. Crossing over / <u>chiasmata</u>	2. No crossing over
3. 2 chromosomes per spindle fibre	3. 1 chromosome per spindle fibre
4. Whole chromosomes either side of equator	4. 1 Chromatid either side of equator
5. Random assortment	5. No random assortment
6. No division of centromere	6. Centromere divided
7. At <u>telophase</u> DNA / chromosome number is halved	7. Number stays the same / is not halved. (<u>not</u> : daughter cells)

Any three points must match (3)

- (ii) Interphase (1)
(allow: S phase)

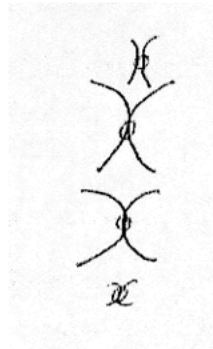
Total 10 marks

6.

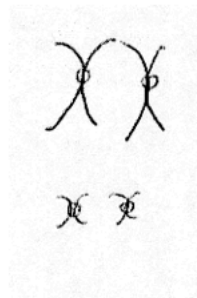
- (a) 12 single structures (chromosomes); 1
Separated from each other; 1
Labels: centrioles, spindle fibres, centromere, chromosomes 2
Max 2 for labels.
- (b) replication DNA;
Centrioles replicate;
Organelles e.g. mitochondria produced;
Protein synthesis;
RNA / nucleotide synthesis;
High rate respiration/ATP synthesis;
Energy store
AVP. e.g. Two chromatids formed.
3
(Max. 3) (not: growth)

7.

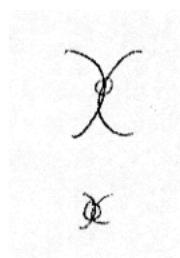
- (a) Correct ID of LS root zone of cell division.
(not: cross in vascular bundle/across all diagram) 2
Correct ID of TS anther zone of cell division.
(allow: to top of root cap but not in root cap)
- Root labelled MITOSIS (correct spelling only).
Anther labelled MEIOSIS (correct spelling only). 2
- (b) Correct drawings as below. 3
(number must be consistent)



On equator



As bivalent, labelled. (Allow: at right angles if poles deleted)



- (c) Correct label for centriole, drawn.
Centromere
Bivalent

One mark each

3

Total 10 marks

8.

- | | | |
|-----|---|----------------|
| (a) | A. Centriole | 1 mark |
| | B. Chromatid | 1 mark |
| | C. Centromere | 1 mark |
| | D. Nuclear membrane | 1 mark |
| (b) | Prophase | 1 mark |
| (c) | (i) Mitosis | 1 mark |
| | (ii) No bivalents shown/no crossing over/no homologous pairs | 1 mark |
| (d) | Asexual reproduction/(Tissue) repair/growth
(not: creates more cells) | 1 mark |
| (e) | Chromatids shorter/thicker
Nuclear membrane broken down
Formation of spindles
Centrioles at either end of cell
(any three)
(not: reference to nucleolus/nucleus breaks down/reference to lining
up on equator or attachment to spindle) | 3 marks |
| (f) | Animal | 1 mark |
| | Higher plants lack centrioles
(independent marks
(not: no cell wall)) | 1 mark |
| | | Total 13 marks |

9.

Available

- (a) B;
A;
C;
D;
(one mark for two correct, two marks for three correct) 2
- (b) (i) prophase; 1
(ii) prophase; 1
(iii) metaphase; 1
(iv) anaphase/early telophase; (not: letters) 1
- (c) replication DNA/chromosomes double;
new organelles produced;
cell increases in size;
ATP production/increased cell respiration
protein synthesis; 3 Max
- (d) produced genetically identical cells;
used for growth/repair;
used for asexual reproduction;
named example; 3 Max
- (e) results in gametes with haploid number/n;
segregates alleles;
crossing over/chiasmata formation;
independent assortment;
chromosome mutation 3 Max
(not: mutation unequal)
- [15]

10.

- (a) (i) B
(ii) D or DC
(iii) A, B (and C) 3 marks
(allow: C in (ii) or (iii) but not both)
- (b) Synthesis of DNA
Synthesis of ATP
Synthesis of protein
Replication of organelles, (Any three) 3 marks
- (c) DNA has halved
because two separate cells have now been formed 2 marks
- (d) No 1 mark
- In both the diploid amount of DNA is present/the reduction
division does not take place until meiosis 2. 1 mark
- (e) Chromosomes at the end of the meiosis 1 are
still double structures/
consist of chromatids still attached at centromere/
are a random assortment of paternal and maternal chromosomes/
have rearranged DNA as a result of crossing over. (Any two) 2 marks

(Total 12 marks)

11.

- (a) D;
F;
C;
G;
H; [5]
- (b) 60 30; (1)
2 4; (1) [2]
- (c) production of haploid gametes;
(not: half DNA/ half number of chromosomes)
so diploid number regained (in zygote);
allows variation;
(not: genetically different)
by crossing over/chiasmata formation;
random assortment;

Max [3]

Total [10]

12.

(a) D; [5]
F;
C;
G;
H;

(b) $\frac{60}{2} \times \frac{30}{4}$; (1) [2]
 $\frac{60}{2} \times \frac{30}{4}$; (1)

(c) production of haploid gametes;
(not: half DNA/ half number of chromosomes)
so diploid number regained (in zygote);
allows variation;
(not: genetically different)
by crossing over/chiasmata formation;
random assortment;

Max [3]

Total [10]

13.

(a) (i) A; [1]
(ii) C; [1]
(iii) B; [1]
(iv) F; [1]
(v) E; [1]
(vi) C; [1]

(b) (i) gamete; [1]
(not: sex cell / haploid)
(ii) used in fertilization;
involves fusion of nuclei;
diploid number / $2n$ restored;
chromosome number would double if mitosis used;
lead to abnormalities in foetus;

[3 max]

(c) independent assortment of chromosomes / random assortment;
(not: random selection)
random fertilization;
mutation.

[2]

Any 2/3

[Total 12 marks]

14.

- (a) (i) metaphase [1]
 (ii) centromere [1]
 (iii) pulls chromatids/chromosomes to opposite poles [1]

(b)

Statement	Stage in cell cycle
Chromosomes shorten and thicken and spindle forms	Prophase
A period of intense activity which includes the replication of DNA	interphase
Formation of two nuclei	Telophase (not: cytokinesis)

[3]

(c)

Meiosis	Mitosis
1 two divisions	One division
2 four daughter cells	Two daughter cells
3 number of chromosomes is halved	Number of chromosomes remains the same
Daughter cells <u>genetically</u> different/variation	Daughter cells genetically identical/no variation
Crossing over	No crossing over
(Homologous chromosomes pair)	(Homologous chromosomes do not associate in pairs)

(any three, last 2 points not expected on new spec.) Matched statements required [3]

15.

- (a) A – interphase (not: resting phase).
 B – mitosis (not: cell division).
 C – prophase. [3]
- (b) (i) Metaphase - both chromosomes on equator, chromatids either side. [1]
 Anaphase – 4 V or U shaped, centromere pointing towards centrioles. [1]
- (ii) Nucleotide synthesis, replication of DNA, replication of organelles, protein synthesis, growth, synthesis ATP.AVP. (Any 2) [2]

[Total 7 marks]

16.

- (a) (i) arrow drawn pointing clockwise; [1]
 (ii) segment drawn after telophase of roughly similar dimensions [1]

- (b) replication of DNA;
 increase in cell size;
 chromosomes exist as chromatids;
 replication of organelles/centrioles;
 synthesis of ribosomal material;
 synthesis of ATP;
 synthesis of protein [4 max]

- (c) (i) metaphase; [1]
 (ii) anaphase [1]
 (iii) anaphase; [1]
 (iv) prophase; [1]
 (v) telophase. [1]

[Total 11 marks]

17.

- (a) [4]

Role	Mitosis	Meiosis
	✓	X
	X	✓
	X	✓
	✓	✓

(not: hybrid ticks)

- (b) joined pair of chromatids;
 chromatid labelled and centromere labelled; [2]
 (c) centromere splits;
 chromatids pulled to (opposite) poles;
 by shortening/ contraction of spindle fibres; [3]
 (d) centrioles; [1]

(Total 10 Marks)

18.

- | | | |
|---------|---|---|
| (a) (i) | J K L H I | 1 |
| (ii) | I = telophase | 1 |
| | L = metaphase | 1 |
| (b) (i) | interphase | 1 |
| (ii) | ATP production/ metabolically active;
Replication of DNA; NOT synthesis/ doubling
{Making/ replacing} new organelles/ replication of
mitochondria/ chloroplasts
NOT replication of organelles
Protein synthesis;
Cell increase in size (not growth) (any two) | 2 |
| (c) | DNA Doubled / DNA content increased from 20 to 40 | 1 |
| | and then halved (to maintain DNA content) (in two daughter
cells.)
(ignore reference to chromosomes) | 1 |
| (d) | Two genetically identical daughter cells are produced;
{Genetically identical/ clone} of parent cell. | 2 |

(Total 10 marks)

19.

- (a) 2 chromosomes in female cell; 2
1 chromosome in male cell;
Diagrams must match each other.
Accept 'chromatids' in each cell. Do not accept chromatid in male cell if chromosomes drawn in female cell or opposite.
- (b) (i) 2 Chromosomes arranged on equator of spindle; (ignore orientation) 2
2 V shaped {chromosomes / chromatids} with centrosomes towards each centriole/pole;
Ecf from one diagram to other.
- (ii) Labelling: chromatids, centromere, spindle, centrioles, equator, cell membrane. 2
2 marks for 4 correct labels on either diagram;
1 mark for 3.
- (iii) To provide {genetically identical cells / clones}; 2
Repair / replacement {of cells / tissue} / regeneration qualified;
NOT growth.
- (iv) Making gametes / sperm cells / sex cells / produce haploid cells for reproduction; 1
- (v) Meiosis / reduction division; 1
Spelling must be correct.
- (vi) Genetic variation (in the offspring) / restore diploid number (in zygote) OWTTE; 1
- (c) Fertilised eggs will develop into females, unfertilised eggs into males; (both for 1 mark); 1
Accept: fertilised will give genetically varied ants, unfertilised would give clones;
IGNORE haploid / diploid.

Question total 12

20.		
(a)	Root <u>tip</u> / shoot <u>tip</u> / meristem;	1
(b)	A Anaphase; B Prophase; C Telophase; D Metaphase;	4
(c)	Interphase; It is the longest phase;	2
(d)	(All cells) would be {haploid/half the number of chromosomes}; NOT cells have fewer/ less chromosomes (All cells) would be genetically different;	2
Question 4 Total		[9]

21.		
(a)	(i) B, D, C, F, E;	1
	(ii) Cytokinesis;	1
(b)	(i) 4 cells are produced compared with 2 / cells are haploid as oppose to diploid/only contain one set of chromosomes compared with two sets of chromosomes; NOT 2 chromosomes (can be neutral) As a result of two (consecutive) divisions;	2
	(ii) (Meiosis produces haploid gametes which) allows the diploid state to be restored {at fertilisation/in the zygote} / prevents doubling of the chromosome number at fertilisation; Meiosis produces <u>genetically</u> different {gametes/cells} / results in <u>genetic</u> variation (in the offspring);	2
Question 2 Total		[6]

Essays

1.

- (a)
- A Follows interphase
 - B During which replication/copying/doubling of DNA/chromosomes occurs
 - C Prophase, metaphase, anaphase, ~~telophase~~, (correct order anywhere in answer)
 - D Chromosomes shorten/thicken/condense
 - E Appear as two chromatids
 - F Joined at centromere
(~~not~~: joined together/pair off/just on diagram)
 - G Centrioles migrate to opposite poles in animal cells
(~~not~~: centrioles divide)
 - H Aster formation/spindle fibres span cell/run from pole to pole/spindle formed
 - I Nuclear envelope/membrane/nucleolus, disappears
 - J Chromatids line up at equator/metaphase plate
 - K Centromeres attached to spindle fibres
 - L Centromeres split
 - M Chromatids/chromosomes drawn apart/to (opposite) poles
 - N By shortening/contraction of spindle fibres
 - O Chromosomes uncoil/lengthen
 - P Nuclear envelope/membrane formed [10]
(~~allow~~: annotated diagrams)
(~~reference~~ to chromosomes instead of chromatids
penalised once only then consequential error;
action in wrong phase penalised)
-

2.

- (a)
- A Interphase, replication of DNA; (not: DNA doubles)
 - B Also replication of organelles;
 - C Synthesis of rRNA/proteins/ATP; (not: metabolic activity)
 - D Prophase chromosomes appear as two chromatids/ ref, condensation;
 - E Joined at centromere;
 - F Nuclear membrane disappears;
 - G Chromosomes line up at equator during metaphase;
 - H Spindle formation;
 - I Centromere divides at anaphase;
 - J Chromatids/chromosomes to opposite poles at anaphase;
 - K Contraction/shortening of spindle fibres;
 - L Nuclear membrane reforms during telophase;
 - M Cytokinesis/cell division occurs by furrowing of membrane/cleavage;
 - N Cytoplasm splits/divides;
 - O Centrioles replicate / move to poles.

Note: ref. to each event must take place in correct stage

10 MARKS

3.

- (a) (i)
- A daughter cells exact copies/genetically identical cells;
 - B same number of chromosomes as parents;
 - C genetic stability;
 - D important for growth;
 - E replacement of missing tissue/parts;
 - F repair to wounds/(damaged) tissue/cell replacement plus e.g. skin/hair/gut lining/blood cells;
 - G asexual reproduction plus e.g. bulbs tubers runners/used by bacteria/yeast;
 - H allows large numbers of offspring to be produced/ref. cloning/quick colonisation;
 - I ref. to cancer i.e. proliferation of cells;

6

- (ii)
- J haploid vs. diploid/mitosis maintains chromosome numbers, meiosis halves it; (not: just 23 vs 46)
 - K two divisions involved;
 - L chromosomes are different/crossing over occurs; (allow: ref. independent assortment)
 - M meiosis produces gametes; (allow: examples e.g. sperm and egg cells; not: sex cells)
 - N allows for variation;
 - O allows sexual reproduction to take place;

4

10